REMARKS

This application has been carefully reviewed in light of the Office Action mailed September 17, 2001. Claims 1, 9, and 16 have been amended. A marked up copy of the amended claims is attached hereto. Reconsideration and favorable action in this application is respectfully requested.

The present invention provides for a method and apparatus for creating a sound signal representing one or more sounds originating in a plurality of positions in space. The method provides for a solution for synthesizing a virtual acoustic environment to listeners where multiple sound sources and their early reflections can be dynamically or statically positioned in three dimensional space. Head-related impulse responses are discretely sampled in space as a continuous function of spatial coordinates of azimuth and elevation. Instead of representing head-related impulse responses using measured discrete samples at several directions, the present invention utilizes a linear combination of a set of eigen filters and a set of spatial characteristic functions.
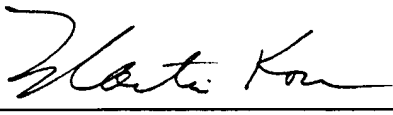
Claims 1, 9, and 16 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Chen et al. These claims have now been amended to more particularly define the present invention as utilizing a method and apparatus for determining a spatial characteristic function for a position in space at which sound originating at multiple positions in space is to be received. Chen et al. represents head-related impulse responses using measured discrete samples at many directions rather than sampling as a continuous function of spatial coordinates as does the present invention. It is therefore respectfully submitted that Claims 1, 9, and 16 as amended clearly define

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over the Chen et al. reference, and are in condition for allowance. Claims 2-8, depending from Claim 1, Claims 10-15 depending from Claim 9, and Claims 17-20 depending from Claim 16 further define the present invention, and it is respectfully submitted that the above-identified dependent claims are also in condition for allowance.

For the foregoing reasons, allowance of Claims 1-20 is respectfully requested.

Respectfully submitted,

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Claims 1, 9, and 16 have been amended.

1.   (Amended) A method for reducing the amount of computations required to create a sound signal representing one or more sounds originating at a plurality of discrete positions in space, where the signal is to be perceived as simulating one or more sounds at one or more selected positions in space with respect to a listener, comprising the steps of:

(a) determining a <u>spatial</u> characteristic function for a position in space at which sound <u>originating at a plurality of positions in space</u> is to be received, wherein said characteristic function represents a head-related impulse response;

(b) applying said characteristic function as a filter to the signal representing sound to produce a filtered signal; and

(c) converting the filtered signal to a sound wave and producing the sound wave for a listener.

9.   (Amended) Apparatus for providing sound created by a sound source to a listener which simulates the sound source at a selected position in space with respect to the listener, comprising:

(a)   an input for receiving a signal representing [a] sound <u>originating at a plurality of positions in space</u>;

(b)   a left channel and a right channel, wherein each channel comprises a filter array for applying a filter to the signal received by the input to provide a filtered signal, the filter comprising a linear function <u>including a spatial component</u> which comprises a head-related impulse response;

(c)   an output for converting the filtered signals from said channels to a binaural sound and for producing the sound for a listener.

16.   (Amended) An apparatus for providing sounds created by a plurality of sound sources to a listener which simulates the origin of each sound at a selected position in space with respect to the listener, comprising:

(e)   an environment input for receiving information concerning a listening

environment to be simulated and relative position of a listener;

(f)   a calculator for receiving the information from said environment input, and calculating attenuation and time delays to simulate said environment and said listener position;

(g)   a signal input for receiving a signal representing [a] sound <u>originating at a plurality of positions in space</u>;

(h)   a left channel and a right channel attached to said calculator and receiving said calculation of attenuation and time delay therefrom, and also attached to said signal input and receiving said sound signal from said signal input, each channel comprising:

> (i)   a source placement array for filtering said sound signal in accordance with a spatial characteristic function, wherein said spatial characteristic function is a head-related impulse response;
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> (ii)   an plurality of eigen filters attached to said source placement array and receiving the signal therefrom, wherein said eigen filters introduce time delays into said signal; and
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> (iii) a signal output for attaching a speaker to the apparatus, attached to said plurality of eigen filters for receiving and summing the signals therefrom.

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